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Remarks:
This application was filed on 21 - 08 - 2000 as a divisional application to the application mentioned under INID code 62.

(54) Apparatus for forming a curl on a first end of a tubular member

(57) An apparatus is disclosed for forming a curl on an end of the applicator. The apparatus includes first and second members. The first member is capable of holding the tubular member and has an external shoulder beyond which the first end of the tubular member extends a set amount. The second member is co-axially aligned with and is engageable with the first end of the tubular member. The second member includes a pilot which is sized to be inserted into the first end of the tubular member. The second member also includes a sleeve which surrounds the pilot and cooperates with the external shoulder when the second member engages the first end of the tubular member to form a curling chamber. The second member further includes a curling element positioned between the pilot and the sleeve which is capable of contacting the first end of the tubular member. The apparatus further includes means for rotating one of the members and means for moving the members into engagement. As the members engage, the curling element contacts the first end of the tubular member and forms a curl thereon within the confines of the curling chamber.

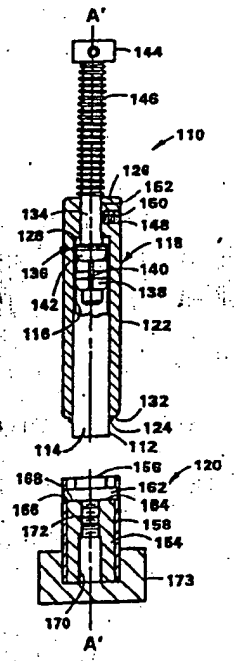


FIG. 12

EP 1 060 720 A1

der when the second member engages the first end of the tubular member to form a curling chamber. The second member further includes a curling element positioned between the pilot and the sleeve which is capable of contacting the first end of the tubular member. The apparatus further includes means for rotating one of the members and means for moving the second member into engagement with the tubular member. When the curling element contacts the first end of the tubular member the curl is formed thereon within the confines of the curling chamber.

[0009] The general object of this invention is to provide an applicator adapted to receive, hold and dispense a substance as well as an apparatus for forming a curl on an end of the applicator. A more specific object of this invention is to provide an apparatus for forming an inwardly or an outwardly extending curl on a tubular member.

[0010] Another object of this invention is to provide an apparatus for forming a curl on an end of an applicator.

[0011] Still further, an object of this invention is to provide an apparatus for forming a curl on an end of a small diameter, paper tube.

[0012] Still further, an object of this invention is to provide an apparatus which can form an outwardly extending, integral curl on a tampon applicator which can serve as a fingergrip.

[0013] A further object of this invention is to provide an apparatus which can form an outwardly extending, integral curl on a tampon applicator which can serve as a fingergrip ring.

[0014] Still another object of this invention is to provide an apparatus which can curl an end of a tubular member quickly and efficiently.

[0015] Still further, an object of this invention is to provide an apparatus which can curl an end of a tubular member in a cost effective manner and at relatively high manufacturing speeds.

[0016] Other objects and advantages of the present invention will become more apparent to those skilled in the art in view of the following description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

Fig. 1 is a side view of an applicator.

Fig. 2 is a cross-sectional view of the applicator shown in Fig. 1 having a tampon pledget retained therein.

Fig. 3 is a partial cross-sectional view of the outer tube showing an integrally formed fingergrip ring having a "hollow c shaped" curl.

Fig. 4 is a partial cross-sectional view of the outer tube showing an integrally formed fingergrip ring having a "closed c shaped" curl.

Fig. 5 is a partial cross-sectional view of the outer tube showing an integrally formed fingergrip ring having a "corrugated c shaped" curl.

Fig. 6 is a partial cross-sectional view of the outer tube showing an integrally formed fingergrip ring having an "e shaped" curl.

Fig. 7 is a partial cross-sectional view of the outer tube showing an integrally formed fingergrip ring having a "right s shaped" curl.

Fig. 8 is a partial cross-sectional view of the outer tube showing an integrally formed fingergrip ring having a "left s shaped" curl.

Fig. 9 is a perspective view of a two piece tampon applicator having an inner tube telescopically slidable with an outer tube.

Fig. 10 is a cross-sectional view of the two piece tampon applicator shown in Fig. 9 having a tampon pledget retained in the outer tube.

Fig. 11 is a side view of an apparatus for forming an outwardly directed curl on an end of a tubular member.

Fig. 12 is a cross-sectional view of an apparatus shown in Fig. 11.

Fig. 13 is an end view of the first member taken along line 13--13 of Fig. 11.

Fig. 14 is an end view of the second member taken along line 14--14 of Fig. 1.

Fig. 15 is an enlarged view showing the interaction of the first and second members to form an outwardly extending curl on one end of the tubular member.

Fig. 16 is an enlarged view of a tubular member having an outwardly extending, integral curl formed on one end thereof using the curling element depicted in Fig. 15.

Fig. 17 is an enlarged view showing the interaction of the first and second members to form an outwardly extending curl on one end of the tubular member.

Fig. 18 is an enlarged view of a tubular member having an outwardly extending, integral curl formed on one end thereof using the curling element depicted in Fig. 17.

Fig. 19 is a cross-sectional view of an apparatus for forming an inwardly directed curl on an end of a tubular member.

grip ring 34 extends radially outward from the central longitudinal axis A--A. The fingergrip ring 34 should have a width "w", see Fig. 1, defined as a distance measured parallel to the central longitudinal axis A--A of between about 0.02 inches to about 0.10 inches (between about 0.5 mm to about 2.54 mm) or more. Preferably, the width "w" is between about 0.05 inches to about 0.08 inches (between about 1.27 mm to about 2.03 mm). The fingergrip ring 34 also has a height "h" extending above the outer surface of the exterior layer 22 of at least about 0.1 inches (about 2.54 mm), see Fig. 2. The height of the fingergrip ring 34 can actually increase the outer diameter of the applicator 10 from between about 5 percent to about 25 percent.

[0027] It is also important that the fingergrip ring 34 have a sufficient height (h) so that it can perform it's three primary functions. In order to properly control the placement of the applicator 10 relative to the user's skin or into a body cavity, the fingergrip ring 34 should have sufficient height (h) to enable the user to feel the fingergrip ring 34 with the tips of her fingers and know where the second end 28 of the applicator 10 is located. The fingergrip ring 34 also aids in allowing the user to position the applicator 10 relative to her vagina by permitting her to pivot the applicator 10 between the tips of her thumb and middle finger. The greater the height (h) of the fingergrip ring 34, the easier it is for the user to pivot the applicator 10 in her hand. The second function is the expulsion of the tampon 14 from the hollow member 12. The fingergrip ring 34 must have a sufficient height (h) so that the user's fingertips do not slip off of the hollow member 12 when the tampon 14 is expelled out the first end 26. For good results, the outside diameter of the fingergrip ring 34 should be at least about 5 percent greater than the outside diameter of the hollow member 12. Preferably, the outside diameter of the fingergrip ring 34 should be from about 8 percent to about 20 percent greater than the outside diameter of the hollow member 12. Most preferably, the outside diameter of the fingergrip ring 34 should be from about 12 percent to about 16 percent greater than the outside diameter of the hollow member 12.

[0028] The third function of the fingergrip ring 34 is to facilitate removal of the applicator 10 away from the user's skin or away from the vagina or other body cavity. The fingergrip ring 34 should have a sufficient height (h) so that this function can be performed without having the user's fingers slip off of the applicator 10.

[0029] Referring again to Fig. 2, the fingergrip ring 34 contains a surface 35 which is essentially perpendicular to the wall 20 of the hollow member 12. This surface 35 must possess sufficient strength so that when the user's fingers exert a force on this surface 35, the first end 26 of the applicator 10 can pivot about the fingergrip ring 34. Such pivoting action facilitates positioning of the applicator 10 relative to a body cavity.

[0030] The strength and stretch characteristics of the material forming the applicator 10 will limit the maximum outside diameter of the fingergrip ring 34. The maximum outside diameter of the applicator 10 can be calculated for different kinds of material using the following formula:

$$\frac{\text{Fingergrip Ring OD - Applicator OD}}{\text{Applicator OD}} = \text{Value} \times 100 = \text{X Percent}$$

where OD = outside diameter.

[0031] Using this formula for applicators constructed out of different kinds of paper, it has been established that the maximum diameter of the fingergrip ring 34 is about 120 percent of the outside diameter of the applicator 10. It should be noted that different materials will yield a different maximum diameter.

[0032] The fingergrip ring 34 must have a sufficient amount of strength to prevent the user's fingers from destroying or uncurling the fingergrip ring 34 during use. The fingergrip ring 34 will encounter three different periods in which a force will be directed on it. The three periods include a controlling period where the applicator is positioned relative to a body cavity, an expulsion period where the substance is expelled into the body cavity and a removal period where the applicator 10 is removed from the body cavity. The first force that the fingergrip ring 34 must be capable of withstanding is a squeezing force as the user positions the applicator 10 adjacent to and into her body cavity. Normally only two fingers are positioned on the fingergrip ring 34 and the force exerted on the fingergrip ring 34 is not uniformly distributed about the circumference thereof. Instead, the force impinges on the circumference of the fingergrip ring 34 at two arcuate locations which are spaced approximately 180 degrees apart. Each arcuate locations can encompass an area defined between about 45 degrees to about 110 degrees. The force during this period can range from about 50 grams to about 200 grams.

[0033] The second force that the fingergrip ring 34 experiences is during the expulsion period and this represents the greatest amount of force. This force will be directed onto the fingergrip ring 34 in a direction parallel to the longitudinal centerline A--A of the hollow member 12 as the substance is expelled into the body cavity. This force will be in an opposite direction to the direction in which the fingergrip ring 34 was curled. The expulsion force of many tampon applicators is in the range of about 250 grams to about 800 grams (about 0.55 lbs to about 175 lbs). Therefore, the strength of the fingergrip ring 34 should be at least about 250 grams (about 0.55 lbs), preferably, greater than about 800 grams (about 1.75 lbs), and most preferably, greater than about 1500 grams (about 3.30 lbs) so as to provide a degr e of safety.

grip ring 34 is substantially greater than the outside diameter of the tube and this means that the paper fibers are altered or stretched in order to occupy the larger diameter of the fing rgrip ring 34. Consequently, the type of material, the thickness of the material, the amount of stretch of the material, the initial outside diameter of the tube, and the outside diameter of the fingergrip ring 34 are all interrelated. Accordingly, two terms that will be used to describe this interaction are "cross-sectional area" and "wall density" of the fingergrip ring 34.

[0045] The "cross-sectional area" of each fingergrip ring 34 is comprised of a percentage of tube material and a complementary percentage of void area 40. The cross-sectional area of each fingergrip ring 34 is comprised of from between about 70 percent to about 95 percent of material and a complementary void area of between about 5 percent to about 30 percent. Preferably, the cross-sectional area of each fingergrip ring 34 is comprised of from between about 80 percent to about 90 percent of material and a complementary void area of between about 10 percent to about 20 percent. This is a much greater percent of material in the fingergrip ring 34 than what is present in existing paper drinking cups where the amount of material present in the curl is between about 10 percent to about 20 percent and the void area is between about 80 percent to about 90 percent. The ratio of material to void area in a fingergrip ring 34 is determined by the type of material from which the ring is formed, the particular height dimension "h" needed, the required strength needed, etc. It has been found that the height and strength of the fingergrip ring 34 are crucial parameters in determining how effective the fingergrip ring 34 is in aiding control, insertion and removal to the applicator 10.

[0046] The "wall density" of each fingergrip ring 34 is determined using the standard definition of density as defined by "Engineering Materials & Their Application," 2nd edition, page 52, published by Flinn/Trojan, copyrighted 1981. Density is defined as "mass divided by volume" and is usually expressed in terms of grams per cubic centimeter or kilograms per cubic meter. In order to form a suitable fingergrip ring 34, the tubular wall 20 should have a density of between about 0.4 grams per cubic centimeters to about 1.0 grams per cubic centimeters. For a two ply paper applicator, a density of about 0.6 grams per cubic centimeters works well. The density of the wall which forms the fingergrip ring 34 is preferably less than the density of the tubular wall 20. However, an acceptable range is between about 20 percent less than the density of the tubular wall 20 to about 20 percent greater than the density of the tubular wall 20.

[0047] The fingergrip ring 34 can be formed by contacting one end of the circumference of the hollow member 12 with a rotating tool. The tool contacts the hollow member 12 and moves parallel to its longitudinal centerline A--A. As the tubular wall 20 is curled into a fingergrip ring 34, the fibers of the inner layer 24, assuming the inner layer 24 is constructed of a material like paper, are stretched and worked. This causes the fibers to be separated or become spaced out on a microscopic scale. The density of the material consequently decreases. If the fingergrip ring 34 is not subsequently compressed, it will be less dense than the hollow member 12 and may contain a void area. It is possible to compress the fingergrip ring 34 and reduce or eliminate the void area. This will cause the fingergrip ring 34 to become more dense. The fingergrip ring 34 could be compressed such that it has a higher density than the tubular wall 20 from which it was formed. However, too much compression creates an unacceptable weak fingergrip ring 34. If the density at the top of the fingergrip ring 34 is increased too much, the fingergrip ring 34 can become brittle and a weak hinge point is thereby created. This is undesirable when using of the fingergrip ring 34 on a tampon applicator 10.

[0048] Referring now to Figs. 9 and 10, a two piece tampon applicator 64 is depicted which includes a first member 66 and a second member 68. The first member 66, or outer tube as it is sometimes referred to, is hollow and is sized and configured to receive and retain a catamenial tampon 14. The first member 66 has an outside diameter of less than about 1 inch (about 25.4 mm), preferably less than about 0.75 inches (about 19.05 mm), and most preferably, less than about .625 inches (about 15.875 mm). The first member 66 can be constructed as taught above for the hollow member 12 and should contain at least two separate and distinct layers. Preferably, at least one of the layers is paper. The second member 68, or inner tube as it is sometimes referred to, is sized and configured to telescopically slide within the inner circumference of the first member 66. The second member 68 is preferably hollow although it does not have to be. As the second member 68 is pushed into the first member 66, the tampon 14 is expelled through the forward end 26 of the first member 66. After the tampon 14 is positioned in a woman's vagina, the applicator 64 is properly discarded.

[0049] Referring to Figs. 11-14, an apparatus 110 for forming a curl on an end of a tubular member 112 is shown. By "tubular member" is meant a member having a cavity or opening 114 formed therein or therethrough with a wall 116 approximate the end which is to be curled. The wall 116 should be relatively thin. The cavity or opening 114 should extend to at least one outside surface thereof. The tubular member 112 can be cylindrical, non-cylindrical, conical, frusto-conical or of some other shape which is opened at one or more ends. The tubular member 112 does not have to have a uniform outside diameter although such a diameter is preferred for many articles.

[0050] Two articles which can be curled by the apparatus 110 include a cylindrical tube which is useful as a tampon applicator and a cylindrical tube which is useful as a medicinal applicator. A tampon applicator facilitates positioning of an absorbent tampon into a woman's vagina and a medicinal applicator can be used to dispense m dication into a body cavity or onto the skin of a human or an animal. One specific application for a medicinal applicator is to dispense medication, such as a yeast infection medication, into a woman's vagina. The curl can be inwardly r outwardly extending. The outwardly extending curl can serve as a fingergrip ring to aid in holding the applicator relative to a woman's vagina.

first end 124 of the housing 122, the tubular member 112 will be displaced from the bore 128. With a majority of the tubular member 112 cleared from the bore 128, the tubular member 112 can be manually removed from the sleeve 138. Once the tubular member 112 is fully removed from th piston 136, the compressed spring 146 will urge the piston rod 134 and the piston 136 back to their original position within the bore 128. The first member 118 will then be ready to accept another tubular member 112 which is to be curled.

[0061] The first member 118 further contains a threaded hole 148 aligned perpendicular to the central bore 128. The threaded hole 148 is designed to receive a set screw 150. The piston rod 134 has a flat surface 152 machined into it which extends along a major portion of it's length between the piston 136 and the enlarged head 144. The set screw 150 is threaded into the threaded hole 148 and contacts the flat surface 152. This action prevents rotation of the piston rod 134 relative to the housing 122. It should be noted that in some situations, the rotation of the piston rod 134 is not undesirable and therefore there will not be a need for the set screw 150.

[0062] The second member 120 of the apparatus 110 is coaxially aligned along the central, longitudinal axis A'--A' of the first member 118 and is movably relative to the first end 124 of the first member 118. For purposes of discussion only, the second member 120 will be described as being aligned vertically below the first member 118, although the members 118 and 120 could be positioned at some other orientation if desired.

[0063] The formation of either an outwardly directed curl or an inwardly directed curl will be dictated by the configuration of the first and second members, 118 and 120 respectively. The configuration needed on the second member 120 to form an outwardly directed curl on one end of the tubular member 112 will first be described. The configuration of the tooling needed to form an inwardly directed curl will be explained later.

[0064] The second member 120 is engageable with the end of the tubular member 112 which extends outward past the shoulder 130 when the tubular member 112 is held in the bore 128 of the first member 118. The second member 120 includes a pilot 154 which is depicted as a cylindrical member. The pilot 154 has a first end 156 of reduced outside diameter which is sized and configured to be inserted into the outwardly extending end of the tubular member 112. Preferably, the first end 156 has a circular cross-sectional profile with an outside diameter which is at least about .002 inches (about .05 mm) smaller than the inside diameter of the tubular member 112. The insertion of the first end 156 of the pilot 154 into the tubular member 112 will assure that the wall 116 of the tubular member 112 cannot curl inward as the first and second members, 118 and 120 respectively, contact one another. The first end 156 of the pilot 154 can be inserted into the tubular member 112 any desired amount. However, the first end 156 of the pilot 154 should be inserted a distance of at least about 0.125 inches (about 3.17 mm) or more into the tubular member 112.

[0065] Referring to Fig. 15, the second member 120 also includes a sleeve 158 which surrounds the pilot 154. The sleeve 158 has an inside diameter which is in contact with the outer diameter of the pilot 154 except near the first end 156. At the first end 156 of the pilot 154, the inside diameter of the sleeve 158 is spaced apart from the outer diameter of the first end 156 of the pilot 154. This clearance establishes an open area around the outer circumference of the tubular member 112 when the first and second members, 118 and 120 respectively, are moved into engagement. The open area provides a circumferential opening into which the outer end of the tubular member 112 can be curled outwardly relative to the central, longitudinal axis A'--A'.

[0066] The inner diameter of the sleeve 158 cooperates with the outer periphery 132 of the shoulder 130 to form a curling chamber 160 when the second member 120 engages an end of the tubular member 112. Preferably, the clearance between the inner diameter of the sleeve 158 and the outer periphery of the shoulder 130 is between about .001 inches to about .005 inches (about .02 mm to about .127 mm). The sleeve 158 and pilot 154 are stationary relative to one another and are designed to move axially together.

[0067] The second member 120 further includes a curling element 162 positioned through the pilot 154 and the sleeve 158 which is designed to contact the outwardly extending end of the tubular member 112 and form a curl thereon. The curling element 162 can be in the form of an elongated pin or cylindrically shaped member. The curling element 162 can be a solid or hollow member. The curling element 162 can also have a uniform outside diameter, as shown in Fig. 15, or a non-uniform outside diameter as depicted in Fig. 17. The curling element 162 is inserted through and retained in two transversely oriented apertures 164 and 166 formed in the sleeve 158 as well as a transversely oriented aperture 68 formed through the first end 156 of the pilot 154. The curling element 162 can be spaced vertically away from the first end 156 of the pilot 154 by a distance of at least about 1/16 of an inch (about 1.58 mm). The exact distance which the curling element 162 is spaced away from the first end 156 of the pilot 154 can vary.

[0068] The pilot 154 also has a central passageway 170 formed therein which is aligned along the central, longitudinal axis A'--A'. At least a portion of the passageway 170 is threaded to receive a set screw 172. The set screw 172 is designed to contact the curling element 162 and prevent it from rotating. It has been found that a better looking and more functional curl can be obtained when the curling element 162 is held stationary. However, for some applications, one may find that the curling element 162 can move or rotate without affecting the final appearance of the finished curl.

[0069] The second member 120 is designed to be inserted into a rotatable chuck 173 and can be rotated at a predetermined speed. The speed can vary depending upon the type of material the tubular member 112 is constructed of. The second member 120 is rotated while the first and second members, 118 and 120 resp ctively, are moved axially

above. The only difference, other than size dimension, is that in the second member 202, the sleeve 158 has a surface 204 which is not aligned flush with the first end 156 of the pilot 154. This embodiment allows the first end 198 of the shaft 192 to engage the first end 156 of the pilot 154. When this occurs, the outer periphery of the first end 156 of the pilot 154 engages the inner periphery of the shoulder 200 and the curling chamber 160 is formed between the grooves 180 and 182 and the inner surface of the sleeve 158. The curling chamber 160 permits the end of the tubular member 112 to have an inwardly directed curl 206 to be formed thereon as the first and second members, 190 and 202 respectively, engage one another.

[0078] It has been found that when forming the inwardly directed curl 206, that a better quality curl can be obtained when the curling element 178, having a non-uniform diameter, is used. However, the material from which the tubular member 112 is constructed, it's wall thickness, it's diameter, the type of curl, etc. all contribute the final quality of the formed curl.

[0079] As stated above, either the first or second members, 190 and 202 respectively, can be rotated and either can be reciprocated toward and away from the other member. Furthermore, the apparatus 188 can include removal means for removing the tubular member 112 from the shaft 192. The removal means can be similar to that described and depicted above in Figs. 11 and 12 or it can be some other mechanism, such as a pneumatic, hydraulic, electrical or electro-mechanical mechanism.

[0080] Referring to Fig. 20, the tubular member 112 is shown having an inwardly extending, integral curl 206 formed on one end thereof. This curl 206 is obtained by using the tooling depicted in Fig. 19. The curl 206 is referred to as an "s" curl having a rounded corner 208 because of it's shape. It has been found that when the curling element 178 has a non-uniform outer diameter, that the rounded corners 208 are obtained.

[0081] It should also be mentioned that formation of the curls 174 and 184 can be enhanced by adding some moisture to the paper tube. The addition of as little as .05 percent moisture is beneficial. Also, the addition of a wax to the end of the tubular member 112 which is to be curled will enhance the finished curl. Lastly, it is possible to heat set the curl 174 and 184 for a predetermined period of time to assure that it retains its shape and to increase it ability to keep it's shape under load. A heat set in the range of about 200°F to about 400°F for a time period of between about 1 second to about 10 seconds works well. An adequate heat set for a curl integrally formed on a tubular member constructed of at least two layers of paper can be obtained by heating the curl to about 300°F for about 3 seconds. Any temperature below the burn melting temperature of the material from which the tubular member 112 is constructed may work provided the time period is adjusted to prevent destruction of the tubular member 112 itself.

[0082] While the invention has been described in conjunction with several specific embodiments, it is to be understood that many alternatives, modifications and variations will be apparent to those skilled in the art in light of the aforegoing description. Accordingly, this invention is intended to embrace all such alternatives, modifications and variations which fall within the spirit and scope of the appended claims.

Claims

1. An apparatus (110, 188) for forming a curl on a first end of a tubular member, comprising:

   a) a first member (118, 190) capable of holding said tubular member (112) and having a shoulder (130, 200) beyond which said first end of said tubular member extends;

   b) a second member (120, 202) coaxially aligned with and engageable with said first end of said tubular member (112), said second member including a pilot (154) sized to be inserted into said first end of said tubular member, a sleeve (158) surrounding said pilot which cooperates with said shoulder (130, 200) when said second member engages said first end of said tubular member to form a curling chamber (160), and a curling element (162) positioned between said pilot and said sleeve which is capable of contacting said first end of said tubular member; and

   c) means for rotating one of said members and moving said members into engagement, said engagement causing said curling element (162) to contact said first end of said tubular member (112) and form a curl thereon within the confines of said curling chamber (160).

2. The apparatus (110, 188) of claim 1 wherein said first member (118) is held stationary and said second member (120) is rotated.

3. The apparatus (110, 188) of claim 2 wherein said second member (120) is reciprocally movable relative to said first member (118).

is sized to receive said tubular member.

21. The apparatus (110, 188) of claim 19 wherein said first member (118) includes means for removing said tubular member from said cavity.

22. The apparatus (110, 188) of claim 19 wherein said first end of said tubular member contains a circumference of 360 degrees and said curling element (162) contacts said circumference at two separate locations simultaneously and the contact area is less than about 50 degrees of said circumference at any time.

23. The apparatus (110, 188) of claim 19 wherein said pilot (154) is inserted into said first end of said tubular member at least .125 inches.

24. The apparatus (110, 188) of claim 1
wherein said curl is an integral curl,
wherein said first member (118) is capable of holding said tubular member stationary,
wherein said first member has an external shoulder (130) beyond which said first end of said tubular member extends a set amount, and
wherein said apparatus comprises means for rotating said second member (120) and moving said members into engagement at a predetermined speed.

25. The apparatus (110, 188) of claim 1
wherein said curl is an inwardly extending, integral curl,
wherein said first member has an external shoulder beyond which said first end of said tubular member extends a set amount and
wherein the curling element (162) is transversely aligned between said pilot (154) and said sleeve (158).

26. The apparatus (110, 188) of claim 25 wherein said first member (190) includes an elongated central shaft (192) which is sized to receive said tubular member.

27. The apparatus (110, 188) of claim 25 wherein said first member (190) includes means for removing said tubular member from said shaft.

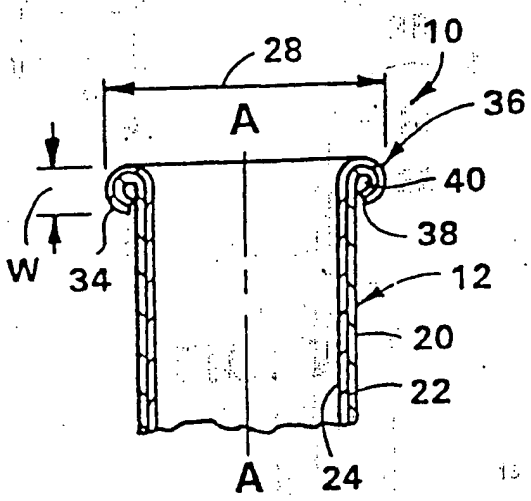


FIG. 3

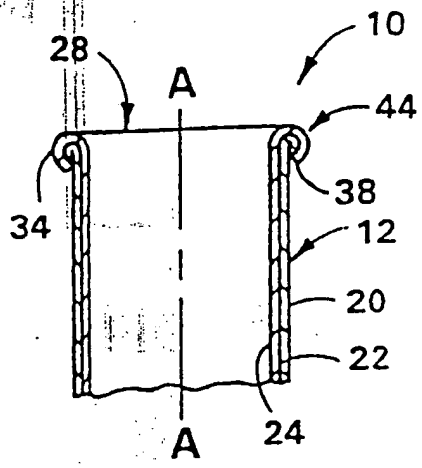


FIG. 4

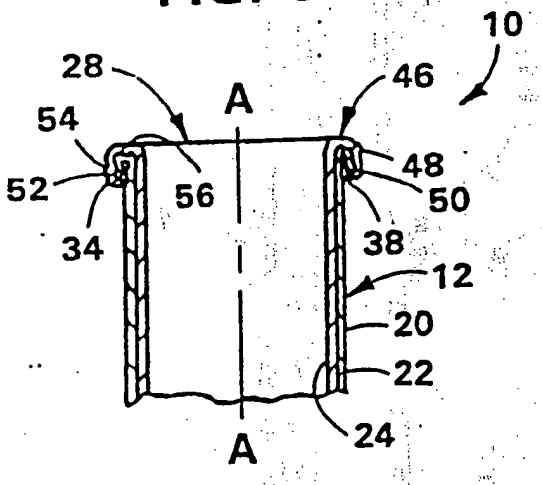


FIG. 5

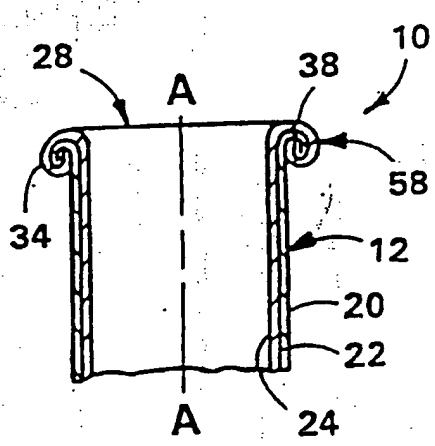


FIG. 6

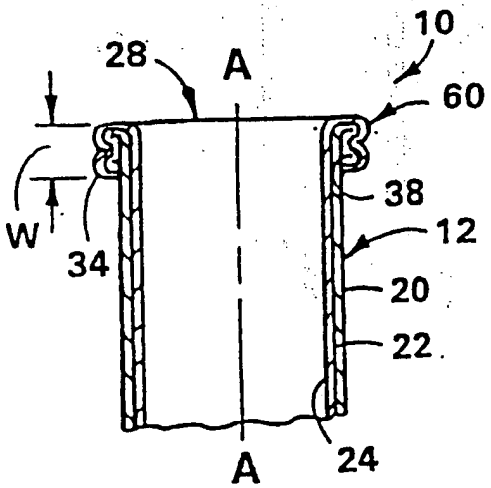


FIG. 7

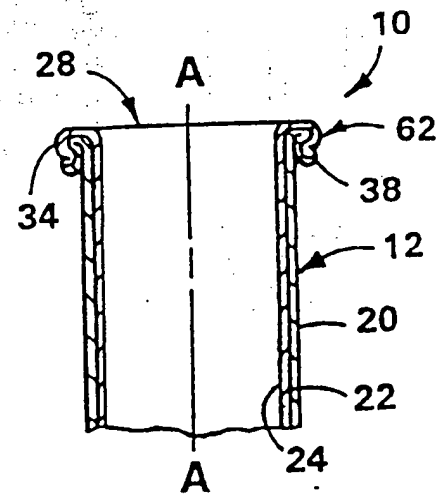
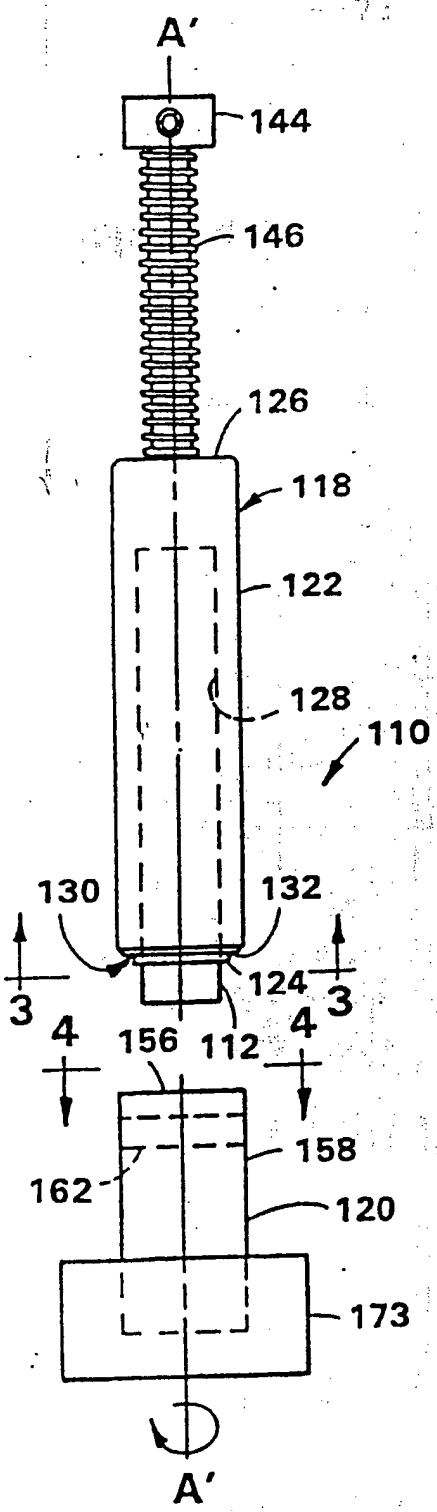


FIG. 8


A'
144
146
126
118
122
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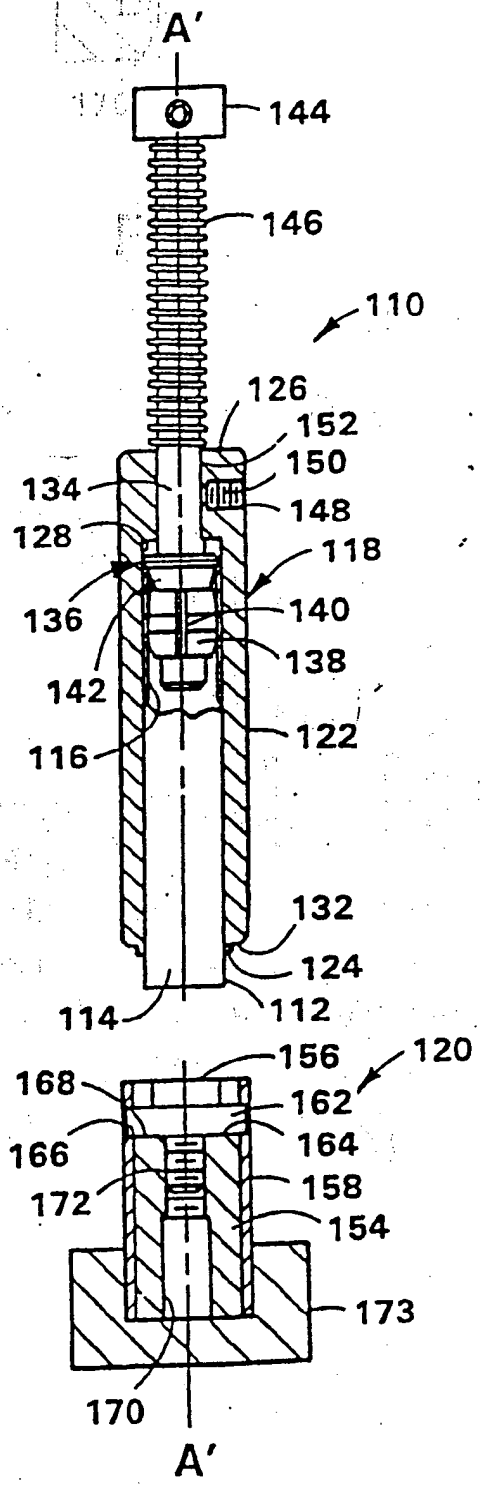
110
130
132
124
3
3
4
4
156
112
158
162
120
173
A'

FIG. 11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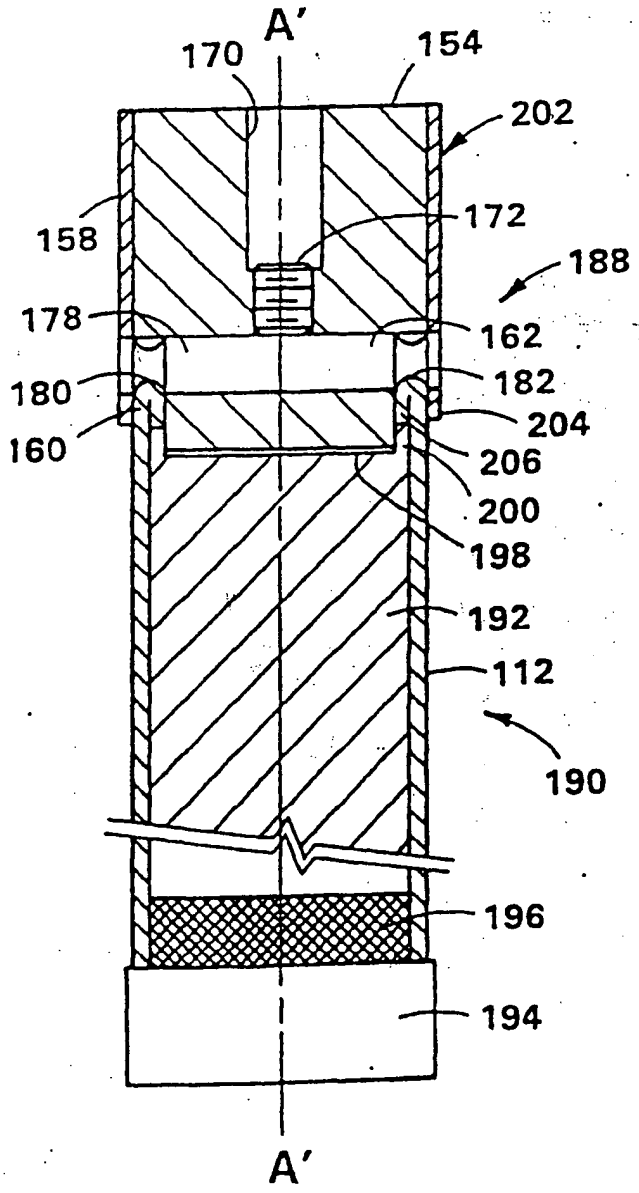
170
A'

FIG. 12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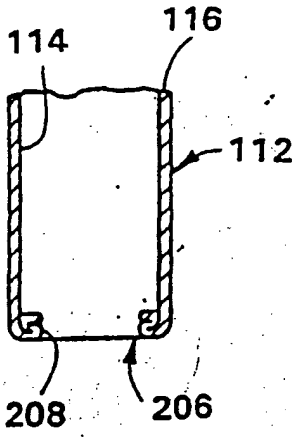
A'

FIG. 19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112
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206

FIG. 20

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